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RICE AND ITS BY-PRODUCTS FOR FEEDING LIVESTOCK

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RICE AND ITS BY-PRODUCTS FOR FEEDING LIVESTOCK

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PRODUCTION OF RICE AND ITS BY-PRODUCTS

The annual production of rice in the United States has increased in the last 30 years from about 100,000 tons of milled rice to more than 500,000 tons. Approximately 40,000 tons of rice bran, 15,000 tons of rice polish, and at least 10,000 tons of brewers' rice are available annually for livestock feeding.

In parts of the coastal plain of the Gulf States, where about three-fifths of the rice crop of the United States is produced, it is the most important grain crop. In southwestern Louisiana and southeastern Texas it is the principal source of cash income. In some parishes and counties in this area more than 75 per cent of the cultivated land is used in a rotation which includes the growing of rice. Other rice-producing areas of nearly equal importance are the grand prairie of Arkansas and the Sacramento Valley of California.

GRAZING OF RICE LANDS

During the pioneer period of the rice industry in the Gulf coast region it was a common practice to use the land continuously for rice production as long as a profitable crop could be grown. Then it was allowed to lie idle for two or more years and again sown to rice for as long a period as a good crop could be obtained. Decreasing margins of profit resulted mainly because of decreased yields, a lower grade of rice resulting from an increased percentage of red rice and weed seeds, and increased costs of pulling weeds and grass during the irrigation and growth of the rice crop. Cattle were rarely grazed on the land during the time it was not being cultivated.

The period during which successive crops of rice could be produced gradually shortened, until it is now a common practice to grow two

[1] Acknowledgment is made of the assistance of T. E. Woodward, senior dairy husbandman, Bureau of Dairy Industry, with respect to portions of this publication dealing with dairy cattle.

crops of rice and then graze the land for two or more years with cattle. Some rice farmers do not graze livestock on rice land. Where grazing is practiced oftentimes seeds of cultivated forage crops are not sown. The grazing capacity of the land so managed is very low, several acres being required for each animal pastured.

Some of the best rice growers are trying out a 2-year rotation, which consists of cultivating half and grazing half of the land each year. As this is a new practice, there is no conclusive evidence regarding its value. Since there are no experimental data on the possible methods of sowing fallowed rice lands to grazing crops in rotation with rice, such work is being begun at the Iberia Livestock Experiment Station of the United States Department of Agriculture located at Jeanerette, La.

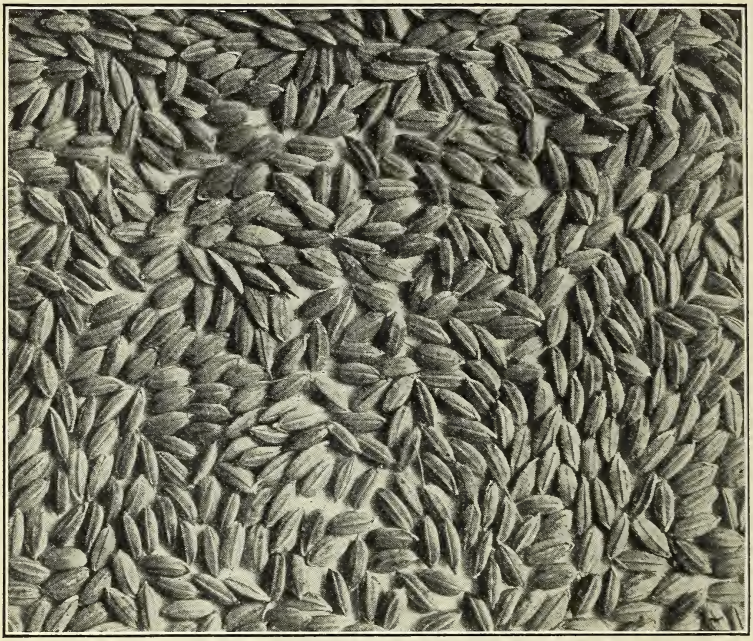

FIGURE 1.—Rough rice of the Wataribune variety. (Natural size)

LIVESTOCK FEEDS OBTAINED AS BY-PRODUCTS IN MILLING RICE

Threshed rice is known as rough rice. The rice kernel is inclosed in a hard hull with small ridges, on the crests of which are sharp, toothlike projections. (Fig. 1.) Directly beneath the hull, but separate from it and attached firmly to the starchy body of the kernel itself, is a light-brown seed coat in which seven distinct layers may be seen with a microscope. The germ, or embryo, is distinctly visible at one end of the kernel. In milling rice first the hull and then the germ and all the layers of bran are removed except a part of the last layer. There is left only the starchy part of the kernel surrounded by a part of the last seed-coat layer, which is very rich in protein. Only about 10 per cent of the protein of the rice kernel is removed by milling. However, about 85 per cent of the oil content

of the kernel is removed, since most of the oil is contained in the germ and the germs go into the bran. Rice bran is a light-brown, fine, flaky material.

The rice is practically white by the time the bran is removed, although it is rather rough. Therefore, it is treated in revolving cylinders, padded with leather, which makes it smooth by removing what is known as rice polish, a fine, light-brown, flourlike material. The very small pieces of broken grains that are removed in the milling operation are called brewers' rice.

In milling a large sample of No. 1 Blue Rose rice, which is intermediate in grain size between the short grain of the Japan type and the long grain of the Fortuna variety, the percentages of first-grade rice and the various rice by-products obtained were as follows:

	Per cent
Milled (head) rice	57
Rice hulls	19
Rice bran	8
Second head milled rice	8
Rice polish	3
Brewers' rice	2
Rice screenings	1

Dirt and shrinkage amounted to about 2 per cent. Other kinds of rice vary in milling chiefly in the quantities of head rice, brewers' rice, and screenings produced.

COMPOSITION OF RICE AND RICE BY-PRODUCTS

The composition of rough rice and its by-products and several similar feeds are given in Table 1.

TABLE 1.—*Percentage composition of rough rice and rice by-products and similar feeds*

Kind of feed	Moisture	Ash	Crude protein	Carbohydrates		Fat or ether extract	Digestible protein	Digestible carbohydrate equivalent [1]
				Crude fiber	Nitrogen-free extract			
Barley	9.6	2.9	12.8	5.5	66.9	2.3	10.4	63.8
Corn	12.9	1.3	9.3	1.9	70.3	4.3	7.1	74.8
Cottonseed hulls	8.7	2.6	3.5	46.2	38.0	1.0	0.2	36.4
Ground ear corn	15.6	1.5	8.3	6.8	64.4	3.4	4.3	66.2
Kafir corn	9.4	1.6	11.1	2.1	72.6	3.2	6.2	54.1
Oats	7.7	3.5	12.5	11.2	60.7	4.4	9.7	56.6
Brewers' rice	12.4	0.6	7.3	0.4	78.5	0.8	5.5	73.1
Rice bran	9.6	10.0	13.8	11.3	40.5	14.8	9.4	60.4
Rice hulls	7.9	19.5	2.7	41.3	27.8	0.8	0.2	30.3
Rice polish	9.4	5.0	12.1	2.1	61.7	9.7	8.1	74.6
Rough rice	9.8	5.4	7.3	8.6	66.9	2.0	5.5	64.2
Wheat	10.6	1.8	12.3	2.4	71.1	1.8	9.8	63.3
Wheat bran	9.6	5.9	16.2	8.5	55.6	4.2	12.5	48.7
Wheat middlings or shorts	10.1	3.5	16.3	4.3	61.6	4.2	13.2	60.1

[1] Sum of the digestible crude fiber, nitrogen-free extract, and 2.5 times the digestible fat.

VALUE OF RICE AND ITS BY-PRODUCTS AS FEED FOR LIVESTOCK

The information on the feeding value of rice and its by-products is based chiefly on the results of feeding experiments carried on by the agricultural experiment stations of Arkansas, California, Louis-

iana, and Texas and the United States Department of Agriculture. Much more information is needed in order to use such products to the best advantage, especially when they are supplemented with Gulf coast products, such as raw sugar, molasses, cottonseed, and fishery by-products.

Brewers' rice and rice polish have practically the same feeding value as corn in a fattening ration except that in the feeding of hogs the quantity of rice polish must be limited on account of its tendency to produce soft pork. When fed in limited quantities rice polish, because of its high fat content and because it is somewhat richer than corn in protein, may have 25 per cent more value than corn. Rice bran and rice polish contain about the same quantity of protein as barley and oats. Rice bran has a much higher ash and fiber content and usually a slightly higher content of protein and fat than rice polish. The proteins of rice are similar in nutritive value to those of other grains and oil-bearing seeds.

Rice straw is only slightly less nutritious than oat and barley straw. When prices for rough rice are low or when it is damaged, rough rice may be used advantageously as feed for livestock. As rice hulls have practically no value as feed they are commonly used for fuel by the mills. The addition of ground hulls to feed is objectionable from a feeding standpoint.

FOR CATTLE

For cows giving milk rice bran is worth, in digestible nutrients, about 5 per cent more than wheat bran and from 75 to 80 per cent as much as ground corn. Fresh rice bran seems to be as palatable as wheat bran when it makes up not more than one-third the total grain ration. Rice polish appears to be equal or slightly superior to ground corn for the production of milk. It has a tendency, however, to make the butter soft if used in too large quantities. As brewers' rice resembles corn in composition and feeding value, for all practical purposes these two products may be considered of equal value for the production of milk, provided they do not form too large a part of the grain ration. Rolled or coarsely ground rough rice may be used in the rations of milk-producing cows in the same way as ground corn.

Rice bran is worth about 10 per cent more than ground milo heads as a supplement to silage and cottonseed meal for fattening steers. In fattening 750-pound steers on a ration of 36 to 38 pounds of silage, 2.6 pounds of cottonseed meal, and about 8 pounds of rice by-products, experiments showed that brewers' rice and rice polish have about the same value in producing gains and about 10 per cent more value than rice bran for the same purpose. (Fig. 2.) In the same experiments 1 pound of cottonseed meal containing 43 per cent of protein was practically equal in feeding value to 2 pounds of rice by-products.

FOR HORSES AND MULES

Good results have been obtained by feeding horses and mules as much as 8 pounds of ground, rough rice daily per 1,000 pounds live weight. The ration may include feeds such as brewers' rice, molasses, rice bran, and corn or oats, and should contain 1 to 1½ pounds of some concentrate rich in protein, such as cottonseed meal.

FOR HOGS

For fattening pigs weighing 60 pounds or more rice bran has about the same value as rolled barley and about 90 per cent of the value of corn, though it does not produce such rapid gains. Not more than 50 per cent of a hog's ration should consist of rice bran or of rice polish, owing to their tendency to produce soft pork, which sells at a lower price than firm pork. The bulkiness of rice bran requires that it be combined with more concentrated feeds such as corn and tankage to have a satisfactory ration for hogs. Rice bran and tankage when self-fed, free choice, to pigs on rye pasture or in dry lot, with or without a supplement of 5 pounds or less of skim milk per animal daily, produced soft carcasses. The rice bran and tankage were fed in separate compartments of the self-feeder so that the pigs could eat as much of each feed as they wanted. The pigs weighed less than 100 pounds when feeding began and made gains up to 100

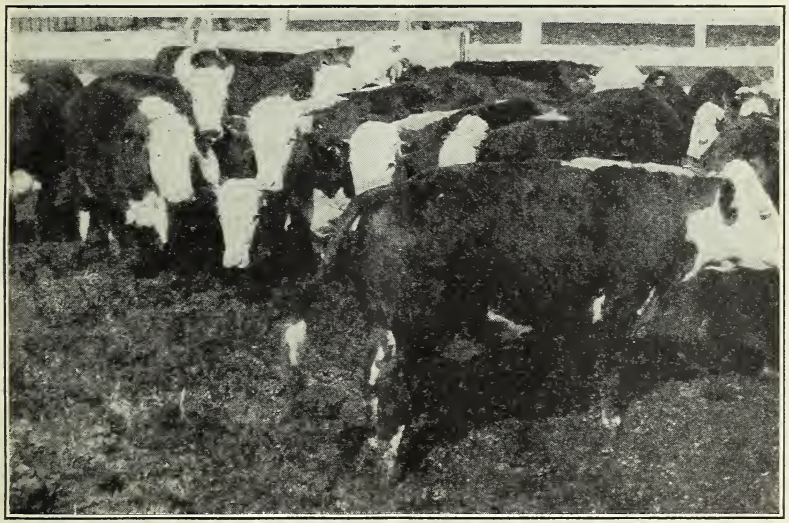

FIGURE 2.—These yearlings were fattened in 140 days on a ration of 9.3 pounds of brewers' rice, 1.8 pounds of cottonseed meal, and 30.1 pounds of sorgo-soybean silage

pounds through a feeding period of from 8 to 16 weeks. Rice bran with tankage followed by corn with tankage does not produce uniformly firm carcasses when fed to pigs with initial weights of from 50 to 114 pounds through equal feeding periods of 8 weeks each.

Rice polish and tankage self-fed, free choice, on oat or rye pasture or in dry lot usually produce soft carcasses in pigs with initial feeding weights of 50 to 114 pounds, making gains of 35 pounds or more through a period of approximately 8 weeks. (Fig. 3.) The carcasses are not firm even though a subsequent gain in weight is made by the pigs on corn with tankage, this gain being equal to that made on the rice-polish ration. In fact, a study made with 75 hogs shows that even when the gain on the corn and tankage ration was 1.79 times the gain on the rice-polish ration the carcasses averaged medium soft in grade. It is believed that rice bran and rice polish, properly supplemented, may be used extensively in feeding brood sows and

their pigs to weaning without danger of soft carcasses in the finished hogs. Experiments show that brewers' rice fed in place of corn, other conditions being equal, produces firm carcasses when the gain on the brewers' rice is twice that on rich polish.

Brewers' rice is a satisfactory feed, having a value very similar to that of corn. Supplemented with protein concentrates largely of animal origin, brewers' rice produces practically as large gains and sometimes even firmer pork carcasses than does corn. Firm carcasses are usually produced in pigs with initial feeding weights of approximately 50 pounds, gaining a maximum of 50 pounds on rations of rice polish or rice bran with tankage during an 8-week

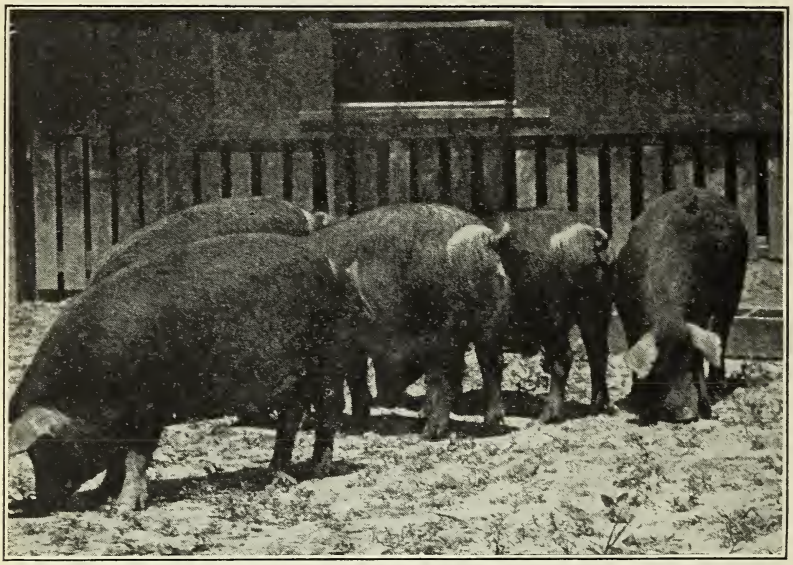

FIGURE 3.—These hogs were fattened on a ration consisting of 50 parts of rice polish, 40 parts of corn chops, and 8 parts of tankage. Courtesy of the Texas Agricultural Experiment Station

feeding period, followed by a gain of at least 70 pounds on brewers' rice with tankage during a period of 8 weeks or more.

Carcasses distinctly firmer than those from corn-fed hogs are usually produced on brewers' rice and tankage self-fed, free choice, on oat pasture, with or without a small supplement of skim milk, hand fed, to pigs with initial weights of approximately 60 pounds, making gains of 150 to 200 pounds throughout feeding periods of 12 to 15 weeks. Brewers' rice produces more rapid gains than barley with about 10 to 15 per cent less feed.

FOR SHEEP

No information has been obtained, under practical conditions, on the use of rice by-products in sheep feeding. It would seem, however, that rice and rice by-products may be used in sheep rations just as other grains and grain by-products of similar nature are used, for sheep have been successfully fed rice by-products in digestion experiments.

FOR CHICKENS

Recent work done by the United States Department of Agriculture shows that rice bran is of considerable value in raising chicks in strict confinement. It apparently contains an accessory food factor necessary for the proper development of leg bones in chicks. For this reason rice bran is valuable in preventing the various types of leg weaknesses, sometimes called enlarged hock, crooked leg, or split tendons.

For laying hens, rice bran, rice polish, and brewers' rice, supplemented with 2 per cent of cod-liver oil, may be substituted for the yellow corn, wheat bran, and shorts commonly used in the mash, provided the cost of feeding is not increased. However, not more than 20 per cent of rice bran should be used. Rough rice may constitute one-third of the scratch mixture for laying hens.

METHODS OF FEEDING RICE BY-PRODUCTS

Brewers' rice, rice bran, and rice polish should be supplemented with some variety of oil meal or a similar feed rich in protein, such as oil-mill, packing-house, fishery, or dairy by-products. In general it is much better to combine rice bran and rice polish in a ration with grain, such as barley or corn, than to feed them alone or with only a small percentage of other concentrates. In former years rice bran and rice polish, because of a high fat and moisture content, sometimes became rancid and molded and caked readily, especially during hot weather. It was necessary, therefore, to use these feeds in the fall and winter, immediately after their production. Modern methods of drying preserve these products very well, and they are suitable for use throughout the year.

According to the Arkansas Agricultural Experiment Station, scouring of animals may occur when rice polish makes up 60 per cent or more of the ration. In cases of scouring limewater may be used as a corrective. Wetting or dampening the rice polish before feeding seems to increase its tendency to cause scours. However, when the rice polish is soaked for 24 hours there seems to be no trouble from scouring.

As the rice grain is very hard, it should be rolled or coarsely ground before it is fed to cattle. In hogs, finely ground rice seems to produce slightly greater and more economical gains than coarsely ground rice.

LIVESTOCK RATIONS CONTAINING RICE OR RICE BY-PRODUCTS

FOR FATTENING 750 TO 800 POUND STEERS IN 125 DAYS TO A WEIGHT OF ABOUT 1,000 POUNDS

Ration 1

	Pounds
Silage	30.0
Oil meal[2]	2.5
Rough rice (rolled or coarsely ground)	10.0

Ration 2

	Pounds
Silage	37.0
Oil meal[2]	2.5
Brewers' rice	8.5

Ration 3

	Pounds
Silage	37.0
Oil meal[2]	2.5
Rice polish	8.5

Ration 4

	Pounds
Silage	37.0
Oil meal[2]	3.0
Rice bran	8.0

[2] Cottonseed meal, linseed meal, or soybean meal.

For cows producing milk, feed 1 pound of one of the following mixtures for each 3 pounds of milk produced:

DAIRY COWS ON PASTURE

	Parts		Parts
Oats	2	Corn	1
Rice bran	2		

DAIRY COWS IN DRY LOT, FED A LEGUME HAY

	Parts		Parts
Brewers' rice	1	Cottonseed meal (41 per cent protein), soybean meal, or peanut meal	1
Oats	1		
Rice bran	1		

DAIRY COWS IN DRY LOT, FED A GRASS HAY

	Parts		Parts
Rice polish	1	Cottonseed meal (34 to 36 per cent protein) or linseed meal	2
Oats	1		
Rice bran	1		

FOR HORSES AND MULES WEIGHING 1,000 TO 1,500 POUNDS AND DOING HARD WORK

Ration 1

	Pounds
Rough rice (rolled or coarsely ground)	8 to 12
Molasses	4 to 6
Cottonseed meal	1 to 1.5
Lespedeza hay	6 to 9
Johnson-grass hay	6 to 9

Ration 2

Brewers' rice	6 to 9
Oats	6 to 9
Soybean meal	1 to 1.5
Soybean hay	6 to 9
Timothy hay	6 to 9

Ration 3

	Pounds
Rice polish	3 to 5
Barley	3 to 5
Corn	5 to 8
Linseed meal	1 to 1.5
Prairie hay	12 to 18

Ration 4

Rice bran	3 to 5
Oats	3 to 5
Grain sorghum	5 to 8
Cottonseed meal	1 to 1.5
Alfalfa hay	6 to 9
Sorgo hay	6 to 9

FOR FATTENING 60-POUND HOGS IN 100 DAYS TO A WEIGHT OF ABOUT 200 POUNDS

Ration 1

	Pounds
Rough rice (finely ground)	5.4
Tankage	.6

Ration 2

Brewers' rice	5.5
Tankage	.5

Ration 3

	Pounds
Barley (rolled)	2.6
Rice polish	2.6
Tankage	.5

Ration 4

Barley (rolled)	2.7
Rice bran	2.6
Tankage	.7

A mineral mixture, such as the following, should be kept where the hogs can get it readily: Ground limestone, 50 parts; steamed bonemeal, 30 parts; common salt, 20 parts.

SCRATCH MIXTURE FOR LAYING HENS

	Parts, by weight		Parts, by weight
Rough rice	1	Yellow corn, wheat, or grain sorghum	1
Oats or barley	1		

MASH FOR LAYING HENS

	Parts, by weight		Parts, by weight
Brewers' rice	20	Ground corn	8
Rice polish	20	Fish meal or dried milk	5
Rice bran	20	Ground limestone	4
Meat scrap	10	Cod-liver oil	2
Alfalfa meal	10	Salt	1

MASH FOR GROWING CHICKS

	Parts, by weight		Parts, by weight
Yellow corn meal	40	Dried milk	5
Rice bran	20	Bone meal	5
Middlings	15	Alfalfa-leaf meal	4
Meat scrap (50 to 55 per cent protein)	10	Salt	1

SUPPLEMENTARY INFORMATION

Supplementary information relating to the production and feeding of rice and rice by-products may be obtained on request from the United States Department of Agriculture, Washington, D. C., and from the agricultural experiment stations of the following States: Arkansas, California, Louisiana, Mississippi, Missouri, Ohio, South Carolina, and Texas.

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